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JEE (ADVANCED) 2023

QUESTIONS & TEXT SOLUTION

PAPER-1

DATE & DAY: 4th JUNE 2023, SUNDAY

PAPER-1	PAPER-2
Duration: 3 Hrs.	**Duration:** 3 Hrs.
Time: 09:00 - 12:00 IST	**Time:** 14:30 - 17:30 IST

SUBJECT: CHEMISTRY

REGISTERED & CORPORATE OFFICE (CIN: U80302RJ2007PLC024029):
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TARGET: JEE (Adv.) 2024

VIJAY COURSE

For 12th Passed Students

Course Features*

- Course Duration: **32 Weeks**
- Total No. of Lectures: **533** (P: 178 | C: 177 | M: 178)
- Duration of One Lecture: **1.5 Hrs.** (90 Minutes)
- Classroom Teaching Hours.: **800 Hrs.**
- Testing Duration: **60 Hrs.**
- Total Academic Hours.: **860 Hrs.**

CLASS STARTS
5th & 19th June

AIR 6
JEE (Adv.) 2022
KARTHIKEYA P.

SCHOLARSHIP UPTO 100%
Based on JEE (Advanced) 2023 Score, Scholarship Test (ResoNET) & 12th Board

TARGET: JEE (Main) 2024

AIR 5
JEE (Main) 2023
KAUSHAL V.

AJAY COURSE

For 12th Passed Students

Course Features*

- Course Duration: **33 Weeks**
- Total No. of Lectures: **571** (P:1 84 | C: 203 | M: 184)
- Duration of One Lecture: **1.5 Hrs.** (90 Minutes)
- Classroom Teaching Hours.: **857 Hrs.**
- Testing Duration: **33 Hrs.**
- Total Academic Hours.: **890 Hrs.**

CLASS STARTS
5th & 19th June

SCHOLARSHIP UPTO 100%
Based on JEE (Main) 2023 Score, Scholarship Test (ResoNET) & 12th Board

PART : CHEMISTRY

PAPER-1 : INSTRUCTIONS TO CANDIDATES

- **Question Paper-1 has three (03) parts: Physics, Chemistry and Mathematics.**
- **Each part has a total Eighteen (17) questions divided into four (04) sections (Section-1, Section-2, Section-3, Section-4)**
- **Total number of questions in Question Paper-1 are 51** and Maximum Marks are **One Hundred and Eighty (180).**

Type of Questions and Marking Schemes

SECTION 1 : 12 Marks

- This section contains **THREE (03)** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the correct answer(s).
- Answer to each question will be evaluated <u>according to the following marking scheme:</u>

  Full Marks : **+4 ONLY** if (all) the correct option(s) is(are) chosen;

  Partial Marks : **+3** If all the four options are correct but **ONLY** three options are chosen;

  Partial Marks : **+2** If three or more options are correct but **ONLY** two options are chosen, both of which are correct;

  Partial Marks : **+1** If two or more options are correct but **ONLY** one option is chosen and it is a correct option;

  Zero Marks : **0** If none of the options is chosen (i.e. the question is unanswered);

  Negative Marks : **−2** In all other cases.
- For example, in a question, if (A), (B) and (D) are the ONLY three options corresponding to correct answers, then

  choosing ONLY (A), (B) and (D) will get +4 marks;

  choosing ONLY (A) and (B) will get +2 marks;

  choosing ONLY (A) and (D) will get +2marks;

  choosing ONLY (B) and (D) will get +2 marks;

  choosing ONLY (A) will get +1 mark;

  choosing ONLY (B) will get +1 mark;

  choosing ONLY (D) will get +1 mark;

  choosing no option(s) (i.e. the question is unanswered) will get 0 marks and

  choosing any other option(s) will get −2 marks.

---

1. The correct statement(s) related to processes involved in the extraction of metals is(are)

(A) Roasting of Malachite produces Cuprite.

(B) Calcination of Calamine produces Zincite.

(C) Copper pyrites is heated with silica in a reverberatory furnace to remove iron.

(D) Impure silver is treated with aqueous KCN in the presence of oxygen followed by reduction with zinc metal.

Ans. **(BCD)**

Sol.

(A) $CuCO_3.Cu(OH)_2 \xrightarrow{\Delta} 2CuO + CO_2(g) + H_2O(g)$

Malachite

$[Cuprite \rightarrow Cu_2O]$

(B) $\underset{\text{Calamine}}{ZnCO_3(s)} \xrightarrow{\Delta} \underset{\text{Zincite}}{ZnO(s)} + CO_2(g)$

(C) $CuFeS_2 \xrightarrow[\text{Reverberatory furnace (Roasting)}]{\Delta} \underset{\text{Copper matte}}{Cu_2S + FeS} + FeO \xrightarrow{SiO_2} \underset{\text{Ironsilicate}}{FeSiO_3}$

(D) Impure $Ag + O_2 + KCN \longrightarrow \underset{\text{Soluble}}{[Ag(CN)_2]^-} + K^+ + OH^-$

$\xrightarrow{Zn(s)}$

$[Zn(CN)_4]^{2-} + Ag(s)\downarrow$

2. In the following reactions, **P**, **Q**, **R**, and **S** are the major products.

$CH_3CH_2CH(CH_3)CH_2CN \xrightarrow[(ii)\ PhMgBr,\ then\ H_2O]{(i)\ PhMgBr,\ then\ H_3O^{\oplus}} \mathbf{P}$

$Ph\text{-}H + CH_3\overset{O}{\overset{\|}{C}}Cl \xrightarrow[(ii)\ PhMgBr,\ then\ H_2O]{(i)\ anhyd.\ AlCl_3} \mathbf{Q}$

$CH_3CH_2\overset{O}{\overset{\|}{C}}Cl \xrightarrow[(ii)\ PhMgBr,\ then\ H_2O]{(i)\ \frac{1}{2}(PhCH_2)_2Cd} \mathbf{R}$

$PhCH_2CHO \xrightarrow[(iii)\ HCN\ (vi)\ H_2SO_4,\Delta]{(i)\ PhMgBr,\ then\ H_2O\ (ii)\ CrO_3,\ dil.\ H_2SO_4} \mathbf{S}$

The correct statement(s) about **P**, **Q**, **R**, and **S** is(are)

(A) Both **P** and **Q** have asymmetric carbon(s).

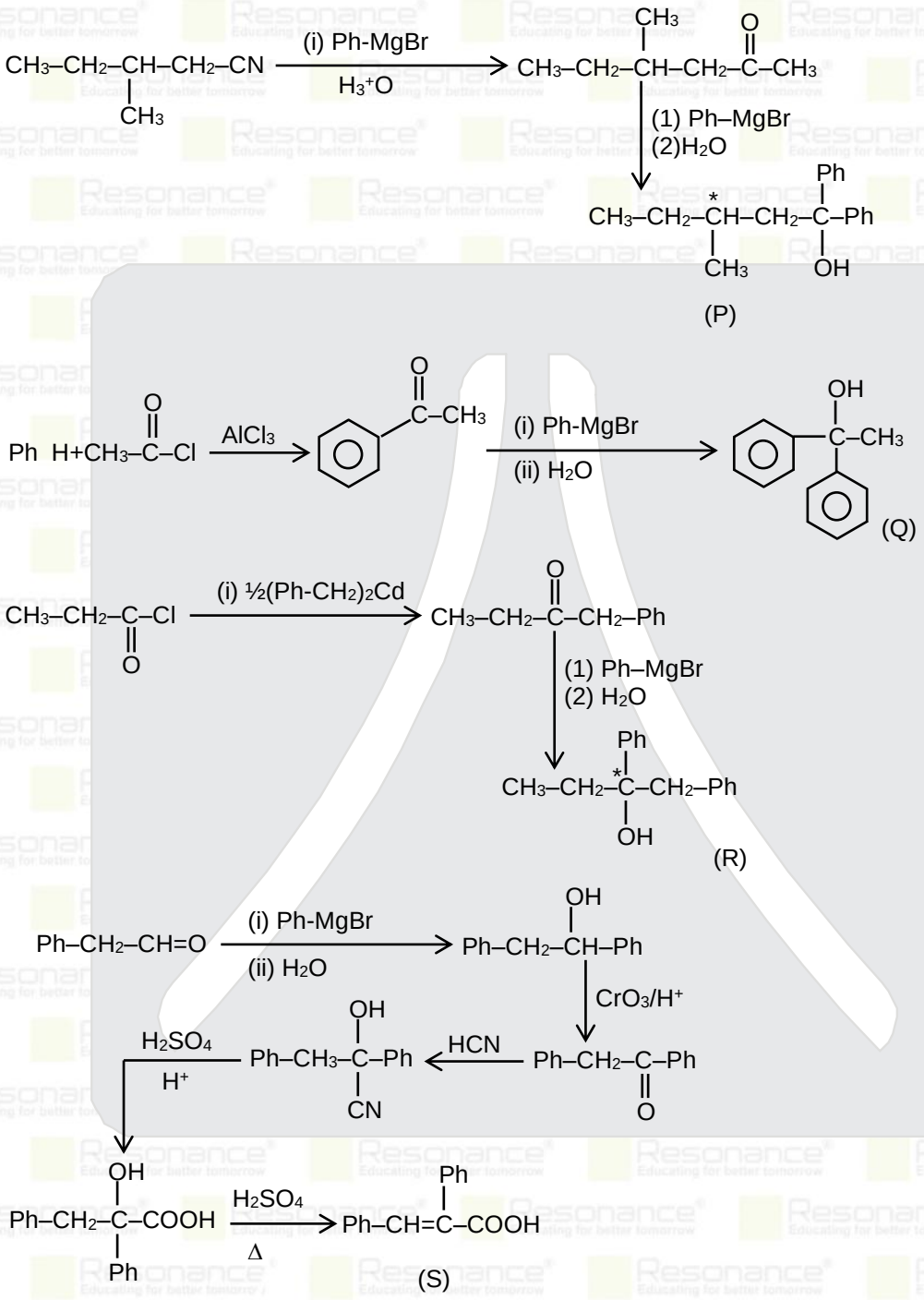
(B) Both **Q** and **R** have asymmetric carbon(s).

(C) Both **P** and **R** have asymmetric carbon(s).

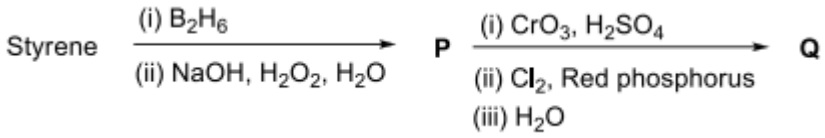
(D) **P** has asymmetric carbon(s), **S** does **not** have any asymmetric carbon.

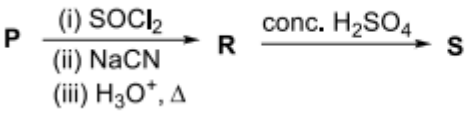
Ans. **(CD)**

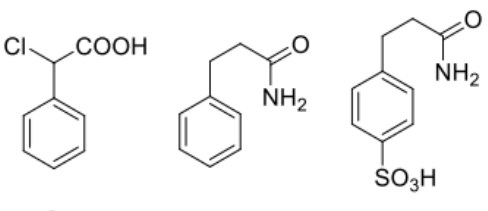
Sol.

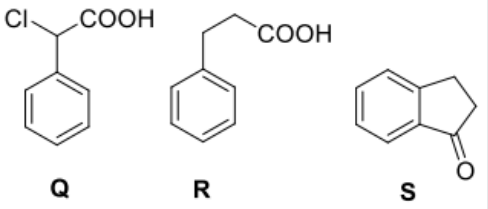

(i) Ph-MgBr
H3+O
(1) Ph–MgBr
(2)H2O
(P)
AlCl3
(i) Ph-MgBr
(ii) H2O
(Q)
(i) ½(Ph-CH2)2Cd
(1) Ph–MgBr
(2) H2O
(R)
(i) Ph-MgBr
(ii) H2O
CrO3/H+
HCN
H2SO4
H+
H2SO4
Δ
(S)

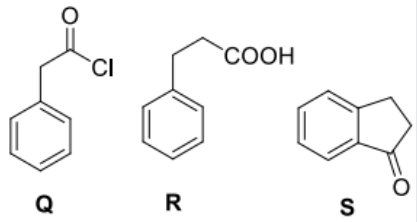
3. Consider the following reaction scheme and choose the correct option(s) for the major products **Q**,**R** and **S**.

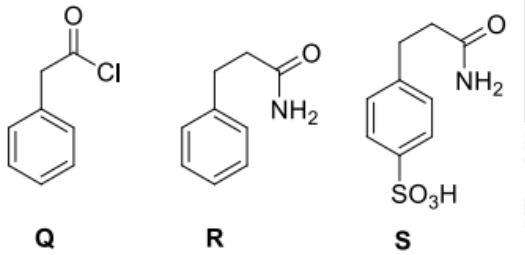




(A) 

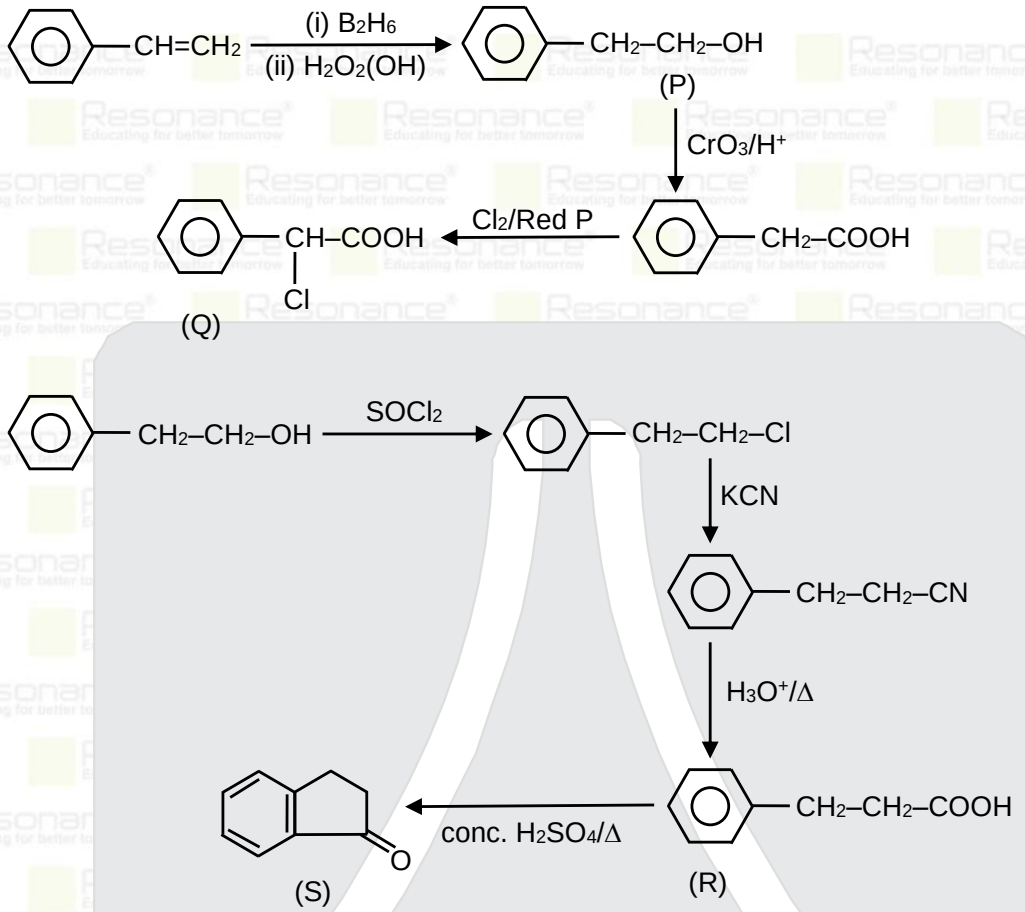
(B) 

(C) 

(D) 

Ans. (B)

Sol.



SECTION-2 : 12 Marks

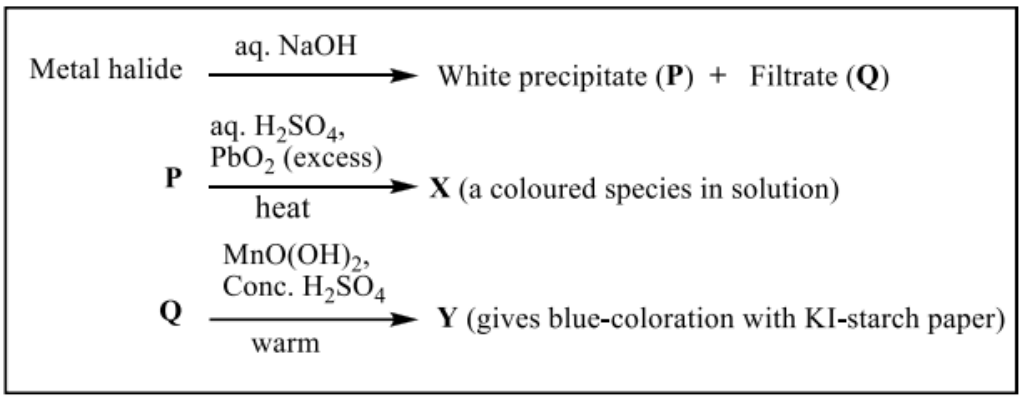
- This section contains **FOUR (04)** questions.
- Each question has FOUR options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.
- For each question, choose the option corresponding to the correct answer.
- Answer to each question will be evaluated according to the following marking scheme:

  Full Marks : **+3** If ONLY the correct option is chosen;

  Zero Marks : **0** If none of the options is chosen (i.e. the question is unanswered);

  Negative Marks : **−1** In all other cases.

4. In the scheme given below, **X** and **Y**, respectively, are



(A) CrO_4^{2-} and Br_2 (B) MnO_4^{2-} and Cl_2 (C) MnO_4^- and Cl_2 (D) $MnSO_4$ and HOCl

Ans. (C)

Sol.

$$MnCl_2 \xrightarrow{\text{aq NaOH}} \underset{(P)\ \text{White ppt}}{Mn(OH)_2} + NaCl(aq)$$

$$Mn(OH)_2 \xrightarrow[\Delta]{PbO_2,\ H^+} \underset{(X)}{HMnO_4\ (\text{Violet solution})}$$

$$NaCl(Q) \xrightarrow[\text{Con. } H_2SO_4\ /\ \Delta]{MnO(OH)_2} Cl_2 + NaHSO_4 + MnCl_2 + H_2O$$

5. Plotting $1/\Lambda_m$ against $c\Lambda_m$ for aqueous solutions of a monobasic weak acid (HX) resulted in a straight line with y-axis intercept of P and slope of S. The ratio P/S is

[Λ_m = molar conductivity

Λ^o_m = limiting molar conductivity

c = molar concentration

K_a = dissociation constant of HX]

(A) $K_a\ \Lambda^o_m$ (B) $K_a\ \Lambda^o_m/2$ (C) $2K_a\ \Lambda^o_m$ (D) $1\ /\ (K_a\Lambda^o_m)$

Ans. (A)

Sol. $\alpha = \dfrac{\lambda_m}{\lambda_m^\infty}$, $K_a = \dfrac{C\alpha^2}{1-\alpha}$

$$K_a = C\left(\frac{\lambda_m}{\lambda_m^\infty}\right)^2 \Bigg/ \left(1-\frac{\lambda_m}{\lambda_m^\infty}\right)$$

$$= \frac{C\lambda_m^2}{\lambda_m^\infty\left(\lambda_m^\infty-\lambda_m\right)} = \frac{C\lambda_m}{\lambda_m^\infty\left(\frac{\lambda_m^\infty}{\lambda_m}-1\right)}$$

$$\frac{\lambda_m^\infty}{\lambda_m} - 1 = \frac{C\lambda_m}{\lambda_m^\infty . K_a}$$

$$\frac{\lambda_m^\infty}{\lambda_m} = 1 + \frac{C\lambda_m}{\lambda_m^\infty . K_a}$$

$$\frac{1}{\lambda_m} = \frac{1}{\lambda_m^\infty} + \frac{C\lambda_m}{(\lambda_m^\infty)^2 . K_a}$$

Intercept = $\frac{1}{\lambda_m^\infty}$ = P, Slope = S = $\frac{1}{(\lambda_m^\infty)^2 . K_a}$,

P/S = $\lambda_m^\infty . K_a$

6. On decreasing the pH from 7 to 2, the solubility of a sparingly soluble salt (MX) of a weak acid(HX) increased from 10^{-4} mol L^{-1} to 10^{-3} mol L^{-1}. The pK_a of HX is

(A) 3 (B) 4 (C) 5 (D) 2

Ans. (B)

Sol. $p^H \quad 7 \longrightarrow 2$

$K_{SP} = 10^{-8}$

$Mx \rightleftharpoons M^+ + X^-$

$S' \quad [X^-]$

$X^- + H^+ \rightleftharpoons HX$

$[X^-] \quad 10^{-2}M \quad S'$

$10^{-8} = S' [X^-]$

$10^{-8} = 10^{-3} [X^-]$ .....(1)

$K_a = \frac{[x^-]10^{-2}}{S'}$

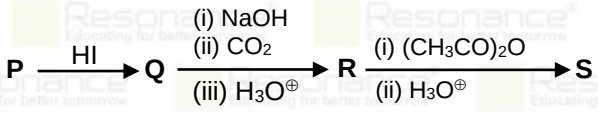
$K_a = \frac{[x^-]10^{-2}}{10^{-3}}$

$K_a = \frac{10^{-5} \times 10^{-2}}{10^{-3}}$ on putting value of $[X^-]$ from (1)

$= 10^{-4}$

or $pK_a = 4$

7. In the given reaction scheme, **P** is a phenyl alkyl ether, **Q** is an aromatic compound; **R** and **S** are the major products.



The correct statement about **S** is

(A) It primarily inhibits noradrenaline degrading enzymes.

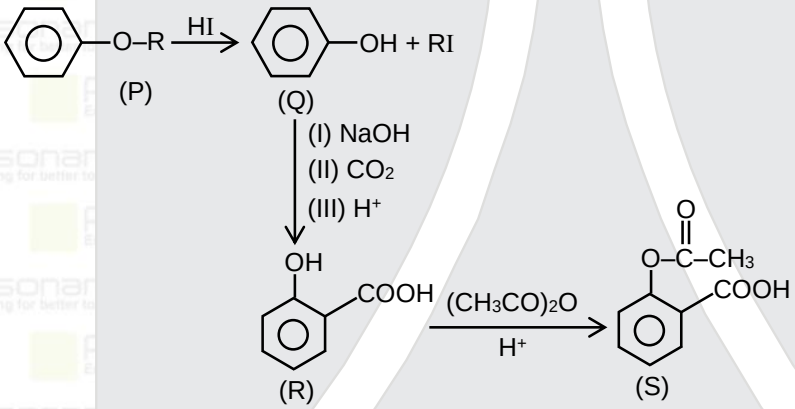
(B) It inhibits the synthesis of prostaglandin.

(C) It is a narcotic drug.

(D) It is *ortho*-acetylbenzoic acid.

Ans. (B)

Sol.



SECTION-3 : 24 Marks

- This section contains **SIX (06)** questions.
- The answer to each question is a **NON-NEGATIVE INTEGER**.
- For each question, enter the correct integer corresponding to the answer using the mouse and the on--screen virtual numeric keypad in the place designated to enter the answer.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : **+4 ONLY** the correct integer value is entered;

Zero Marks : **0** In all other cases.

8. The stoichiometric reaction of 516 g of dimethyldichlorosilane with water results in a tetrameric cyclic product **X** in 75% yield. The weight (in g) of **X** obtained is_____.

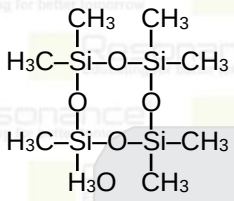
[Use, molar mass (g mol^{-1}): H = 1, C = 12, O = 16, Si = 28, Cl = 35.5]

Ans. (222)

Sol.

$(CH_3)_2\ SiCl_2$

↓ (i) Hydration
(ii) Polymerisation



$(CH_3)_2SiCl_2 = \frac{516}{129} = 4$ mol

on Applying POAC on Si

$1 \times n_{(CH_3)_2SiCl_2} = 4 \times n_{tetramer}$

$n_{tetramer} = 1$ mol

$\downarrow \times 296 \frac{g}{mol}$

296g

$296 \times \frac{75}{100} = 222$ g

9. A gas has a compressibility factor of 0.5 and a molar volume of 0.4 $dm^3\ mol^{-1}$ at a temperature of 800 K and pressure **x** atm. If it shows ideal gas behavior at the same temperature and pressure, the molar volume will be **y** $dm^3\ mol^{-1}$. The value of **x/y** is.

[Use: Gas constant, $R = 8 \times 10^{-2}$ L atm $K^{-1}\ mol^{-1}$]

Ans. (100)

Sol. $Z = \frac{PV_m}{RT}$

$0.5 = \frac{X.0.4}{RT}$

$X \times 0.4 = 0.5\ RT$

$X \times 0.4 = 0.5\ R \times 800$

$X = R \times 1000$

$PV_m = RT$

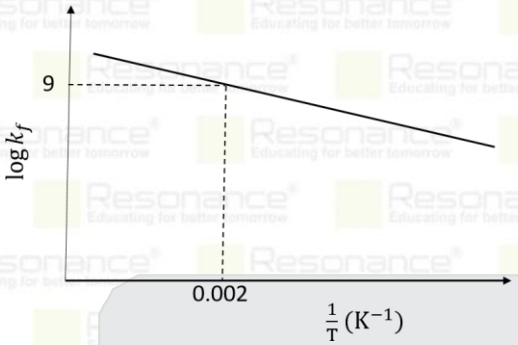
$R \times 1000 \times Y = R \times 800$

$Y = 0.8$

$\frac{X}{Y} = \frac{R \times 1000}{0.8} = \frac{0.08 \times 1000}{0.8}$

$\frac{X}{Y} = 100$

10. The plot of log k_f versus $^1/_T$ for a reversible reaction A (g) ⇌ P (g) is shown.



Pre-exponential factors for the forward and backward reactions are 10^{15} s^{-1} and 10^{11} s^{-1},respectively. If the value of log K for the reaction at 500 K is 6, the value of | log k_b | at 250 K is_____.

[K = equilibrium constant of the reaction

k_f = rate constant of forward reaction

k_b = rate constant of backward reaction]

Ans. **(5)**

Sol. $\frac{1}{T} = 0.002$

$T = 500$

$\log k_f = 9$

$k_f = 10^9$

$\log K_{eq} = 6$

$K_{eq} = 10^6 = \frac{k_f}{k_b} = \frac{10^9}{k_b}$

$k_b = 10^3$ (at 500 K)

$A_b = 10^{11}$

$\log k_b = \log A_b - \frac{(Ea)_b}{2.303R(500)}$

$3 = 11 - \frac{(Ea)_b}{2.303R(500)}$

$\frac{(Ea)b}{2.303R} = 4000$

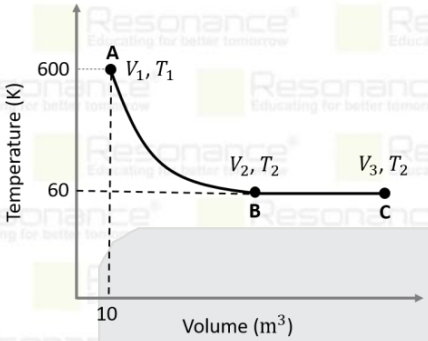
| log k_b | at 250 ?

$\log k_b = \log A_b - \frac{(Ea)_b}{2.303R(250)}$

$= 11 - \frac{4000}{250} = 11 - 16$

| log k_b | = 5

11. One mole of an ideal monoatomic gas undergoes two reversible processes (A → B and B → C) as shown in the given figure:



A → B is an adiabatic process. If the total heat absorbed in the entire process (A → B and B → C) is RT_2 ln 10, the value of 2 log V_3 is_____.

[Use, molar heat capacity of the gas at constant pressure, $C_{p,m} = \frac{5}{2}R$]

Ans. **(7)**

Sol. A – B (Adiabatic)

Monoatomic gas $\gamma = 5/3$

$T_1V_1^{\gamma-1} = T_2V_2^{\gamma-1}$

$600\ V_1^{5/3-1} = 60\ V_2^{5/3-1}$

$10.V_1^{2/3} = V_2^{2/3}$

$10(10)^{2/3} = V_2^{2/3}$

$V_2 = 10^{5/2}$ ….(i)

$q_{A-B} = 0$, $q_{B-C} = W = RT_2\ln\frac{V_3}{V_2}$

$q_{Total} = q_{A-B} + q_{B-C}$

$RT_2\ln 10 = 0 + RT_2\ln\frac{V_3}{V_2}$

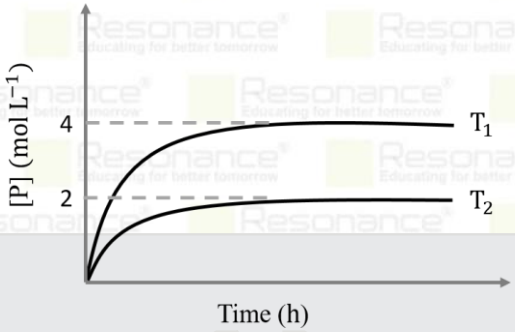
$\frac{V_3}{V_2} = 10$

$V_3 = 10\ V_2 = 10^{7/2}$ from (i) put value of V_2

$\log V_3 = 7/2$

$2\log V_3 = 2 \times \frac{7}{2} = 7$

12. In a one-litre flask, 6 moles of A undergoes the reaction A (g) ⇌ P (g). The progress of product formation at two temperatures (in Kelvin), T_1 and T_2, is shown in the figure:



If $T_1 = 2T_2$ and $(\Delta G_2^{\ominus} - \Delta G_1^{\ominus}) = RT_2 \ln x$, then the value of x is__.

[$\Delta G_1^{\ominus}$ and $\Delta G_2^{\ominus}$ are standard Gibb's free energy change for the reaction at temperatures T_1 and T_2, respectively.]

Ans. (8)

Sol. $\Delta G_1^0 = -RT_1 \ell n \frac{4}{2}$

$\Delta G_2^0 = -RT_2 \ell n \frac{2}{4}$

$\Delta G_2^0 - \Delta G_1^0$

$= -RT_2 \ell n\left(\frac{1}{2}\right) + RT_1 \ell n2$

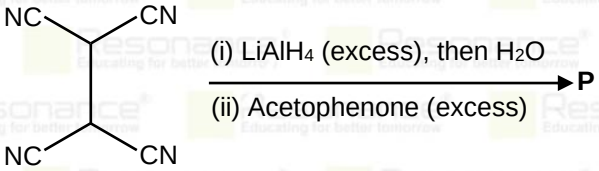
$= -RT_2 \ell n \frac{1}{2} + R2T_2 \ell n2$

$= RT_2 \ell n \frac{4}{1/2}$

$= RT_2 \ell n8 = RT_2 \ell nx$

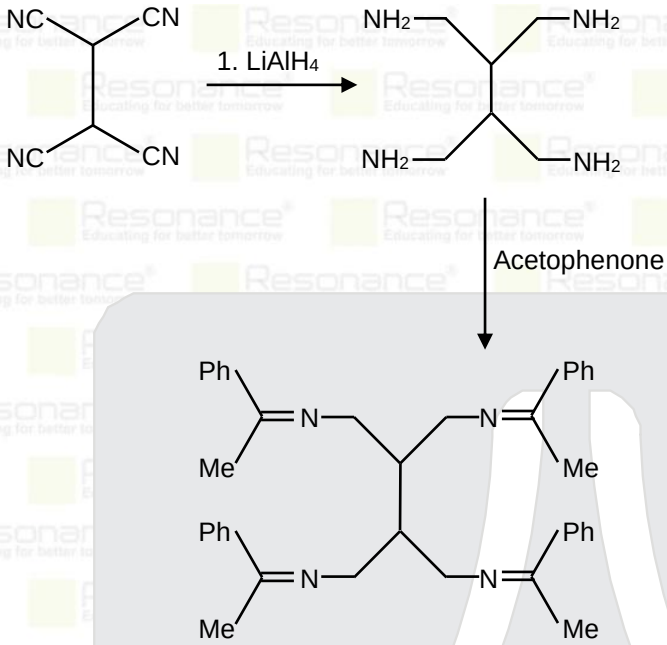
$\Rightarrow x = 8$

13. The total number of sp^2 hybridised carbon atoms in the major product **P** (a non-heterocyclic compound) of the following reaction is_____.



Ans. **28**

Sol.



SECTION 4 : 12 Marks

- This section contains **FOUR (04)** Matching List Sets.
- Each set has **ONE** Multiple Choice Question.
- Each set has **TWO** lists: **List-I** and **List-II**.
- **List-I** has **Four** entries (P), (Q), (R) and (S) and **List-II** has **Five** entries (1), (2), (3), (4) and (5).
- **FOUR** options are given in each Multiple Choice Question based on **List-I** and **List-II** and **ONLY ONE** of these four options satisfies the condition asked in the Multiple Choice Question.
- Answer to each question will be evaluated according to the following marking scheme:
  Full Marks : **+3 ONLY** if the option corresponding to the correct combination is chosen;
  Zero Marks : **0** If none of the options is chosen (i.e. the question is unanswered);
  Negative Marks : **–1** In all other cases.

14. Match the reactions (in the given stoichiometry of the reactants) in List-I with one of their products given in List-II and choose the correct option.

List-I	**List-II**
(P) $P_2O_3 + 3H_2O \rightarrow$	(1) $P(O)(OCH_3)Cl_2$
(Q) $P_4 + 3NaOH + 3H_2O \rightarrow$	(2) H_3PO_3
(R) $PCl_5 + CH_3COOH \rightarrow$	(3) PH_3
(S) $H_3PO_2 + 2H_2O + 4AgNO_3 \rightarrow$	(4) $POCl_3$
	(5) H_3PO_4

(A) P $\rightarrow$ 2; Q $\rightarrow$ 3; R $\rightarrow$ 1; S $\rightarrow$ 5
(B) P $\rightarrow$ 3; Q $\rightarrow$ 5; R $\rightarrow$ 4; S $\rightarrow$ 2
(C) P $\rightarrow$ 5; Q $\rightarrow$ 2; R $\rightarrow$ 1; S $\rightarrow$ 3
(D) P $\rightarrow$ 2; Q $\rightarrow$ 3; R $\rightarrow$ 4; S $\rightarrow$ 5

Ans. **(D)**

Sol. $P_2O_3 + H_2O \longrightarrow H_3PO_3$
$P_4 + NaOH + H_2O \longrightarrow PH_3 + NaH_2PO_2$
$PCl_5 + CH_3COOH \longrightarrow CH_3COCl + POCl_3 + HCl$
$H_3PO_2 + H_2O + AgNO_3 \longrightarrow H_3PO_4 + HNO_3 + Ag$

15. Match the electronic configurations in List-I with appropriate metal complex ions in List-II and choose the correct option.
[Atomic Number: Fe = 26, Mn = 25, Co = 27]

List-I	List-II
(P) $t_{2g}^6 e_g^0$	(1) $[Fe(H_2O)_6]^{2+}$
(Q) $t_{2g}^3 e_g^2$	(2) $[Mn(H_2O)_6]^{2+}$
(R) $e^2 t_2^3$	(3) $[Co(NH_3)_6]^{3+}$
(S) $t_{2g}^4 e_g^2$	(4) $[FeCl_4]^-$
	(5) $[CoCl_4]^{2-}$

(A) P → 1; Q → 4; R → 2; S → 3
(B) P → 1; Q → 2; R → 4; S → 5
(C) P → 3; Q → 2; R → 5; S → 1
(D) P → 3; Q → 2; R → 4; S → 1

Ans. **(D)**

Sol. $[Mn(H_2O)_6]^{+2} \longrightarrow 3d^5$ + weak ligand $t_{2g}^3\ e_g^2$
$[Fe(H_2O)_6]^{+2} \longrightarrow 3d^6$ + weak ligand $t_{2g}^4\ e_g^2$
$[Co(NH_3)_6]^{+3} \longrightarrow 3d^6$ + strong ligand $t_{2g}^6\ e_g^0$
$[FeCl_4]^{-1} \longrightarrow 3d^5$ + weak ligand $e^2\ t_2^3$

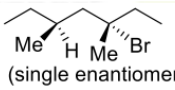
16. Match the reactions in List-I with the features of their products in List-II and choose the correct option

List-I

(P) (-)-1-Bromo-2-ethylpentane (single enantiomer) $\xrightarrow[S_N2 \text{ reaction}]{\text{aq. NaOH}}$

(Q) (-)-2-Bromopentane (single enantiomer) $\xrightarrow[S_N2 \text{ reaction}]{\text{aq. NaOH}}$

(R) (-)-3-Bromo-3-methylhexane (single enantiomer) $\xrightarrow[S_N1 \text{ reaction}]{\text{aq. NaOH}}$

(S) 

(single enantiomer) $\xrightarrow[S_N1 \text{ reaction}]{\text{aq. NaOH}}$

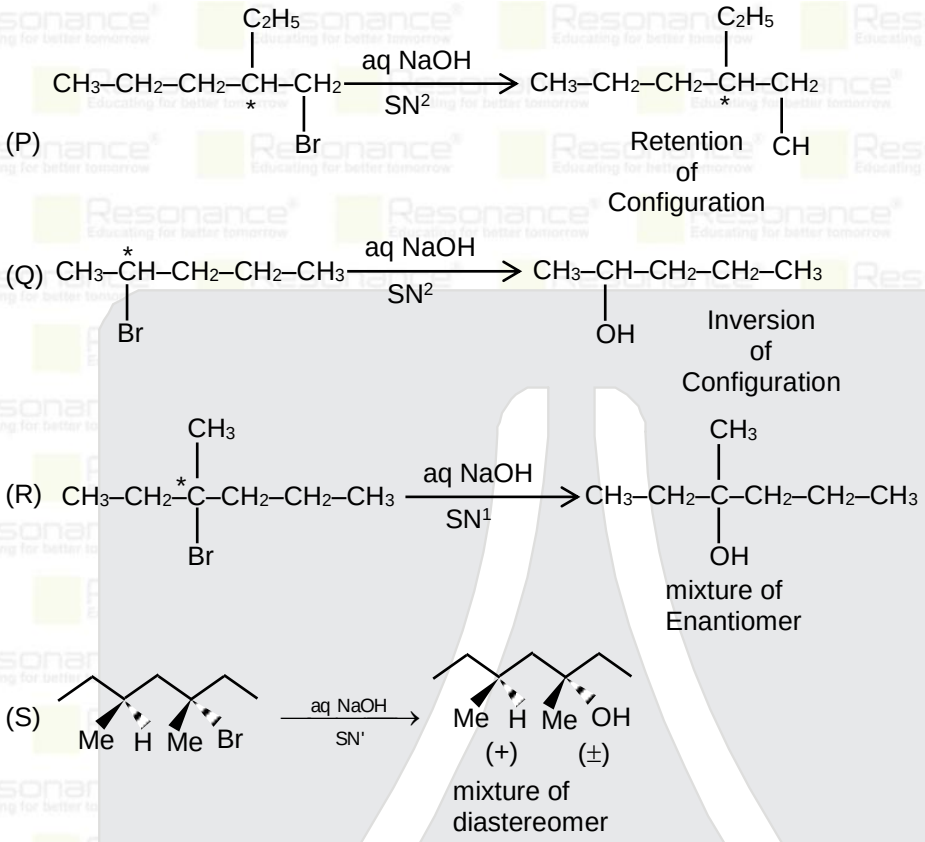
List-II

(1) Inversion of configuration
(2) Retention of configuration
(3) Mixture of enantiomers
(4) Mixture of structural isomers
(5) Mixture of diastereomers

(A) P → 1; Q → 2; R → 5; S → 3
(B) P → 2; Q → 1; R → 3; S → 5
(C) P → 1; Q → 2; R → 5; S → 4
(D) P → 2; Q → 4; R → 3; S → 5

Ans. **(B)**

Sol.

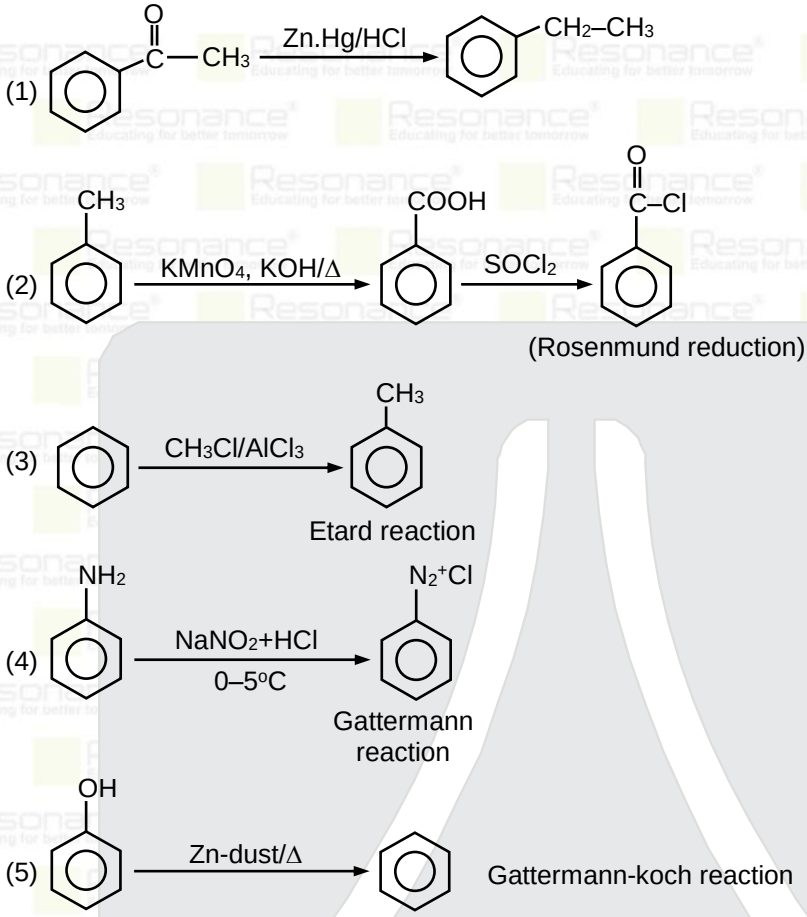


17. The major products obtained from the reactions in List-II are the reactants for the named reactions mentioned in List-I. Match List-I with List-II and choose the correct option.

List-I	List-II
(P) Etard reaction	(1) Acetophenone $\xrightarrow{\text{Zn-Hg, HCl}}$
(Q) Gattermann reaction	(2) Toluene $\xrightarrow[\text{(ii) } SOCl_2]{\text{(i) } KMnO_4, KOH, \Delta}$
(R) Gattermann-Koch reaction	(3) Benzene $\xrightarrow[\text{anhyd. } AlCl_3]{CH_3Cl}$
(S) Rosenmund reduction	(4) Aniline $\xrightarrow[273\text{-}278\ K]{NaNO_2/HCl}$
	(5) Phenol $\xrightarrow{Zn, \Delta}$

(A) P → 2; Q → 4; R → 1; S → 3
(B) P → 1; Q → 3; R → 5; S → 2
(C) P → 3; Q → 2; R → 1; S → 4
(D) P → 3; Q → 4; R → 5; S → 2

Ans. (D)


(1)
O
C
CH3
Zn.Hg/HCl
CH2–CH3
(2)
CH3
KMnO4, KOH/Δ
COOH
SOCl2
O
C–Cl
(Rosenmund reduction)
(3)
CH3Cl/AlCl3
CH3
Etard reaction
(4)
NH2
NaNO2+HCl
0–5°C
N2+Cl
Gattermann reaction
(5)
OH
Zn-dust/Δ
Gattermann-koch reaction

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